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8 September 1961

MEMORANDUM FOR: Chief, Technical Plans and Development Staff

SUBJECT: Calibration of the Image Quality Meter

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1. As a result of the recent inspection of the Image Quality Meter being produced by the [redacted] and the verbal discussion of this item with the Chief, Technical Plans and Development Staff, a directive was issued to the undersigned to investigate standards for those meter readings which will be obtained on this instrument. To recapitulate, these three measures of image quality, as indicated by this device, are: (a) resolution, (b) acutance and (c) granularity. Perhaps an acceptable definition of these terms is in order.

a. Resolution. The ability of an optical or photographic system to reproduce fine detail is defined as its resolving power. Two major items are involved, the lens and the emulsion. The effective resolution is a function of both and is generally specified in terms of the greatest number of lines per millimeter which can be distinctly recorded. The over-all resolving power of the system is always less than the resolving power of either of its components. The US Bureau of Standards has, for the past several years, discontinued the use of lines per millimeter evaluation and has substituted sine wave response as a more accurate and definitive measure of a photographic system. It has been suggested by the Chief, Technical Plans and Development Staff, that this office consult with personnel of the US Bureau of Standards on the matter of calibrating the Image Quality Meter readings in standards which will be acceptable on a national basis.

b. Acutance. The concept of acutance arose from the need for measuring objectively the ability of a photographic system to produce sharp imagery in terms of physical measurement of sharpness. Whereas sharpness is a subjective measure based on a visual comparison, acutance is based on physical measurements intended to correlate with the visual assessment of sharpness. The knife edge of two divergent densities D_1 and D_2, as measured on a microdensitometer, will produce an S-shaped trace. The departure from the true vertical is an indication of sidewise scatter. The departure of the S-curve from the vertical (w) is measured between two points at which the slope of the S-curve of density plotted against distance has a given minimum value. If the slope of the curve at any one point is G_n and is measured at N points within w, acutance is defined as $A = \frac{1}{N} \sum_{n=1}^{n} (G_n)^2 \times (D_1 - D_2)$. i.e., as the average of the squared slopes times the density range across the knife edge.

c. Granularity is a term referring to the structure of the photographic emulsion as represented by the measured variation in the distribution of an apparently uniform silver deposit. It is a scientific concept whereas graininess is a subjective impression. It could be defined as the average grain size of the developed silver halides as observed with a microscope or recorded by a microdensitometer trace. To assign values or numbers to this concept would require that the absolute density also be specified.

2. In addition to the three meter readings, as described above, there is also an oscilloscope trace produced by the Image Quality Meter and a provision for following or recording this trace. This display is, in effect, similar to the recorded microdensitometer trace of the area being scanned by the Image Quality Meter. Since the first of these instruments was designed and built for this Agency, it is appropriate that the same Agency take the initiative in establishing nationally acceptable standards of image quality as produced by this new instrument. It is entirely possible that other instruments of this type will be sold to government, military and even commercial research organizations. It is, therefore, propitious that all persons using these instruments be able to communicate and correlate results. To accomplish this, a prior agreement on the meter calibrations is absolutely necessary. The US Bureau of Standards is the nationally acceptable agency in the field of calibrating lenses and evaluating photographic emulsions. It follows that our concurrence, guidance and approval of these meter calibrations would be most helpful in establishing national standards.

3. The Image Quality Meter is presently scheduled for delivery to this Agency during this calendar year and very possibly within the next sixty days. STATINTL Personnel of the [redacted] are at this moment in need of the calibration data. It is suggested that personnel of the Technical Plans and Development Staff be given proper direction through appropriate channels to begin work immediately with the US Bureau of Standards.

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